UK public beliefs about fracking and effects of knowledge on beliefs and support

UK public beliefs about fracking and effects of knowledge on beliefs and support: a problem for shale gas policy

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Abstract
This paper discusses a survey of public opinions on hydraulic fracturing ('fracking') for shale gas, conducted with a representative sample of 1745 British adults. Unusually, it examines beliefs about positive and negative statements about fracking as well as support/opposition. A majority of respondents correctly answered an initial question testing basic knowledge of shale gas extraction. More respondents supported fracking in Britain (36%) than opposed it (32%) but only 22% supported fracking locally, while 45% were opposed. Respondents were more united in negative beliefs than positive beliefs about fracking. More knowledgeable participants held more polarised views and were significantly more likely than others to agree with negative statements and to oppose fracking in their local area. More respondents disagreed than agreed that it is possible to compensate for fracking risks by payments to local communities. Policy implications include: increasing public knowledge about fracking will not necessarily lead to more positive beliefs and support regarding shale gas developments; promoting alleged economic benefits of shale gas is not enough to ensure support; engaging in genuinely inclusive participatory decision-making may be more likely to increase support than offering payments to communities; alternatively, developing more renewable energy capacity promises to be more popular than fracking.

Highlights
► Results of a survey of a representative sample of 1745 British adults
► Respondents were more united in negative beliefs than positive beliefs about fracking
► More knowledgeable respondents more likely than others to agree with negative statements
► Much less support for fracking 'within 10 miles of home' than in Britain generally
► Acceptance of alleged economic benefits of fracking does not ensure support

Keywords
Hydraulic fracturing, fracking, shale gas, risk perceptions, public attitudes, local opposition

1. Introduction

In January 2014, then Prime Minister David Cameron announced that the UK was 'going all out for shale', arguing that developing shale gas resources would ensure jobs and economic security (UK Government, 2014). The UK's shale gas potential is believed to be considerable, though there are as yet no national estimates of how much gas could actually be recovered, due to uncertainties about the geology and costs of production (Jones et al., 2015; Williams et al., 2017). Shale gas is extracted using a process of hydraulic fracturing,

otherwise known as 'fracking', which involves drilling horizontally into layers of rock and injecting water, sand, and chemicals at high pressure to fracture the rock and release the gas. There has been vociferous opposition to fracking in the UK (Jones et al., 2013), including protests at shale gas exploration sites and damage to a drilling rig owned by oil and gas company Cuadrilla (Vaughan, 2017a). Cuadrilla has complained of 'harassment' by 'irresponsible protesters' (Vaughan, 2017b), while police are alleged to have illegally bullied and intimidated protesters (O'Riordan, 2015).

Overcoming opposition and securing support for fracking is important to policymakers. For example, David Cameron, writing in *The Telegraph*, stated that 'Fracking has become a national debate in Britain – and it's one that I'm determined to win' (Cameron, 2013). Institutional rhetoric suggests that the issue is that the public do not understand 'the facts' about fracking and therefore fail to recognise the benefits and worry unnecessarily about environmental impacts (Williams et al., 2017). However, although there have been several surveys asking about support for fracking, and some deliberative studies exploring public attitudes in more detail, there has been little research involving a representative sample examining what the British public think about a wide range of arguments for and against fracking. This paper addresses that gap, presenting the findings of a survey which investigated support *and* beliefs about positive and negative statements about fracking, among respondents with and without basic knowledge about shale gas extraction.

In the next section I review the literature on arguments for and against fracking for shale gas, and findings of other research into public opinion in Britain. In section 3 I then detail the survey design and methods of data collection and analysis for this study. I present and discuss the results in section 4, and section 5 considers conclusions and policy implications that can be drawn from the study.

2. Literature review: the great fracking debate

Bomberg identifies two clear discourse coalitions in UK fracking debates. The pro-shale gas group, promoting a 'shale gas as opportunity' storyline, frames the debate in terms of economic growth, energy security, reassurance about risks of fracking, and shale gas as a 'bridge' to a lower-carbon energy future. The anti-fracking group, which regards shale gas as a threat, frames fracking in terms of environmental and health risks, fossil fuel 'lock-in', and bad governance. She argues that although neither of these narratives has achieved total dominance, the anti-fracking one has the upper hand because the pro-shale gas coalition lacks trustworthy messengers, and their opponents 'have successfully expanded the debate beyond economic or environmental concerns to include potent issues of local power and democracy' (2017: 72).

These debates are largely played out through the media. There was a rapid rise in media coverage about fracking from 2011, starting in the USA and spreading to the UK and Australia, mirrored by an increasing number of Google searches using the term 'fracking', and growing public concern and opposition (Mazur, 2014). Jaspal and Nerlich (2014) analysed the coverage in four British newspapers, which showed that *The Telegraph* and *The Times* are in favour of fracking and *The Guardian* and *The Independent* are against; this influences their coverage of events. For example, *The Guardian* and *The Independent* focussed a lot of attention on reports of drilling-related seismic activity in Blackpool in 2011, while *The Times* and *The Telegraph* minimised the threat. McQueen (2017) examined the top twenty stories about fracking on the BBC website between January 2013 and December 2015 and found that while most articles made some effort to include views from both sides of the debate, the majority of contributions were either broadly in favour of fracking or else presented the view that science supports the case for it.

2.1. Arguments for and against fracking

2.1.1. Economic arguments

Claims about the economic benefits of shale gas – economic growth, job creation, lower gas prices, and financial benefits for local communities – form the main part of the pro-fracking argument (for example, see Cameron, 2013). In 2008 Pennsylvania gained $238 million in tax revenues and 29,000 new jobs due to shale gas extraction, while by 2011 the Barnett Shale in Texas yielded $11.1 billion in annual output and 100,000 jobs, nearly 10% of regional employment (Sovacool, 2014: 254). Natural gas prices in the USA have fallen dramatically from $13 per million BTUs to $1 to $2 in 2012 due to shale gas, and cheap gas also creates cheap electricity (Sovacool, 2014: 253). In January 2014, UK Prime Minister David Cameron announced that local councils would keep all the business rates associated with shale gas sites, which the Government claimed 'could be worth up to £1.7 million a year for a typical site'; local communities would receive £100,000 when fracking occurs at a test well, and 1% of revenues if shale gas is successfully produced (UK Government, 2014).

However, Sovacool (2014) argues that over the long term, and taking all costs into consideration, fracking may not actually be profitable. Uncertainty arises from the fact that this is a young industry; predictions of well performance over years are based on little experience. In their first year of operation, most shale gas wells experience very fast decline rates of 60-80%, though this then slows, and MIT researchers have estimated that most USA shale gas wells failed to make an expected 10% return (Sovacool 2014: 259). A review by Kinnaman (2011) concludes that industry estimations of the economic benefits of shale gas extraction are very likely to be overstated, due to questionable assumptions. Furthermore, the chair of fracking company Cuadrilla, Lord Browne, has contradicted UK Government claims that fracking will reduce gas prices (Carrington, 2013).

Regarding jobs, if shale gas extraction proceeds similarly to conventional energy developments, local people and especially women may fail to gain high-paying jobs in the industry, which demands particular experience and skills, attracting a male-dominated workforce from beyond the region (Measham et al., 2016). This could lead to significant local income inequalities between those working in the shale gas industry and other businesses and services. Regions where fossil fuel extraction occurs often have lower income growth than those that don't, due to over-specialisation and limited growth in alternative sectors; additionally, a concentrated male workforce on short-term contracts can lead to social problems (Measham et al., 2016).

It is also argued that exploiting shale gas can reduce reliance on uncertain foreign sources of energy, thus improving energy security (Dernbach and May, 2015). However, this could equally be true of replacing imported fossil fuels with renewable energy.

2.1.2. Environmental arguments

Shale gas is associated with lower emissions of mercury, sulphur oxides, and nitrogen oxides than coal and oil (Sovacool, 2014). It is also claimed that shale gas will lead to lower carbon dioxide (CO_2) emissions than coal and act as a 'bridge' to a lower-carbon future, helping to meet energy demand until enough renewable and nuclear capacity can be developed to do so (Engelder, 2011; Leadsom, 2015). Sovacool (2014: 253) states that in the USA, the use of shale gas has decreased CO_2 emissions associated with the national electricity grid, due to displacing coal, and could potentially reduce emissions by up to 17% compared to a 'business as usual' scenario.

However, this may be an over-simplification. The reduced use of coal in the USA has simply led to more use in Europe and Asia, due to increased American coal exports (Cotton et al., 2014; Sovacool, 2014). Broderick and Anderson (2012: 2) calculate that 'more than half of the emissions avoided in the US power sector may have been exported as coal.' In a globalised world it does not make sense to limit analysis of the effects of shale gas production to a single country.

Furthermore, the claim that shale gas production results in lower greenhouse gas emissions than coal is contested; Howarth and Ingraffea (2011) assert that over timescales of less than about 50 years, the greenhouse gas footprint of shale gas is greater than that of coal, due to methane gas leakage during production.

Critics also argue that investment in shale gas extraction is likely to be at the expense of renewables (Bosworth, 2014; Howarth and Ingraffea, 2011). Lower gas prices mean that wind energy has not overtaken natural gas in terms of new electricity generating capacity installation in the USA, as was expected before the shale gas boom (Sovacool, 2014). Researchers at the Tyndall Centre for Climate Change Research claim that 'without a meaningful cap on global carbon emissions, any emissions associated with shale gas are likely to be additional, exacerbating the problem of climate change' (Tyndall Centre, 2011: 109). Kersting et al. (2017) calculate that over the long term, increased availability of shale gas leads to higher greenhouse gas emissions for most countries and the world as a whole, and greater costs of compliance with climate policy for most countries.

Cotton et al. (2014) suggest that the UK Government's pro-fracking arguments focussed on energy security and economic benefits frame shale gas increasingly as a destination rather than as a transition fuel, undermining the 'bridge' argument. Arguments about the abundance of supply (Sovacool, 2014) also weaken this contention, and threaten to create fossil fuel 'lock-in'.

Environmental impacts (and related health risks) form a major part of the argument against fracking. Apart from climate change-related concerns, these include water contamination and availability, earthquakes and tremors, noise and disruption to local residents, general damage to the local environment, and health risks from, for example, air pollution (Dernbach and May, 2015; Howarth and Ingraffea, 2011; Sovacool, 2014). Effects of shale gas extraction on water quality and availability are among the most prominent and well-documented risks (Dernbach and May, 2015; Sovacool, 2014). Industry representatives claim that fracking does not cause water contamination; this may be technically correct in that it is not generally the process of hydraulic fracturing *per se* that is to blame, but water contamination due to shale gas extraction (mostly because of faulty well-casing and cementing) is well-documented (Dernbach and May, 2015). The UK Government argues that regulation will ensure that health, safety and environmental risks of fracking are 'managed effectively' (UK Government, 2017). Comments from DECC staff on former Energy Minister Andrea Leadsom's blog about fracking (2015) state: 'regulators will perform rigorous and ongoing checks and balances to ensure on-site safety, prevent water contamination, and mitigate seismic activity. Companies are legally responsible for their operations and we will insist on exceptionally high standards of health safety and environmental protection.'

2.2. Public opinion

There are two ongoing surveys which track British public opinion on shale gas extraction. Beginning in March 2012, researchers at Nottingham University have repeatedly fielded questions via YouGov's omnibus survey (O'Hara et al., 2015). The first question tests basic knowledge of shale gas extraction (see section 3.2 below); only those who correctly answer

this question proceed to the rest of the survey, which asks whether respondents associate shale gas with three negative and five positive impacts (e.g. earthquakes, energy security), before asking whether shale gas extraction should be allowed in the UK. While the first survey in March 2012 found that 53% of respondents supported shale gas extraction and 27% were against, a differential of +26%, the latest iteration, in September 2016, showed a negative differential (−4%) for the first time, with 37% of respondents supporting shale gas extraction but 41% believing it should not be allowed in the UK. Apart from the first question, this survey is not directly comparable to the present study as the question wording is significantly different.

The UK Government's Energy and Climate Change Public Attitudes Tracker survey[1] which is carried out four times a year via face-to-face in-home interviews, has included questions about shale gas since September 2012. The introduction to the questions is worded as follows:

> *Shale gas is a natural gas found in shale, a non-porous rock which does not allow the gas to escape. Hydraulic fracturing or "fracking" is a process of pumping water at high pressure into shale to create narrow fractures which allow the gas to be released and captured. The gas can then be used in the same way as conventional or natural gas.*

This is an example of McQueen's (2017) claim that the UK Government often omits mention of chemicals being used in the fracking process; overall the tone of the information suggests reassurance (e.g. that shale gas is similar to conventional gas). Respondents are asked how much they knew previously about shale gas; from December 2013, they have been asked 'From what you know, or have heard about, [*sic*] extracting shale gas to generate the UK's heat and electricity, do you support or oppose its use?' and from December 2015, reasons for support, opposition, or no view have been enquired about. The most recent results, from June/July 2017, show that 78% have some awareness of fracking, though only 56% claim to know at least 'a little' about it; 16% support shale gas extraction and 33% oppose it. The most common reason for support was 'Need to use all available energy sources' (42% of those supportive), and the most common reason for opposition was 'Loss/destruction of natural environment' (68% of those opposed).

Qualitative research has also explored public views of fracking. Several different research projects involving deliberative public workshops have discovered common themes: doubts about the trustworthiness of policymakers and industry actors, and the information they provide about fracking; desire for transparency, accountability, and inclusive and participatory decision-making, and a perception that these are lacking; concerns about the uncertainties around fracking and that policymakers are complacent about risks; and a focus on these risks and on doubts about claimed benefits of fracking (Thomas et al., 2017; TNS BMRB, 2014; Williams et al., 2017). The concerns are not limited to specific risks, but encompass disquiet about whether fracking is compatible with longer-term objectives such as sustainability and responsibilities towards future generations (Partridge et al., 2017).

Research analysing the influence of knowledge about fracking on support for shale gas extraction reveals varied results. In the USA, some studies suggest that greater knowledge/familiarity is associated with lower levels of support and higher risk perceptions (Boudet et al., 2014; Choma et al., 2016), but Stedman et al. (2016) found support and knowledge about fracking to be unrelated in the USA. In contrast, knowledge appears to be positively associated with support in the UK (Andersson-Hudson et al., 2016; Stedman et al., 2016; Whitmarsh et al., 2015). Why, then, has support decreased and opposition increased as more people become aware of fracking in the UK? A higher proportion of men are in favour

[1] See https://www.gov.uk/government/collections/public-attitudes-tracking-survey.

than women, and men are also more likely to have basic knowledge about fracking; the downturn in support for shale gas extraction appears to be driven by the opinions of women as more of them become aware of fracking and express a decided rather than neutral view (O'Hara et al., 2015). It could be, therefore, that the idea that knowledge leads to support is an oversimplification, and that earlier survey findings merely reveal that both knowledge and support are predicted by gender.

3. Method

3.1. Data collection

The data reported in this study were collected via the inclusion of five questions in an online omnibus survey fielded by YouGov from 8-9 March 2015 involving 1745 British adults. YouGov has a panel of over 800,000 members and uses targeted quota sampling and statistical weighting to ensure the results are representative of British adults in terms of age, gender, social class, region, level of education, and vote at the last election. Table 1 details characteristics of the sample.

3.2. Survey design

The first question was taken from the Nottingham tracker survey (see Andersson-Hudson et al., 2016); it is designed to test whether respondents possess basic knowledge about hydraulic fracturing, rather than relying on self-assessment of their understanding of the term. The question read:

> *This is a fossil fuel, found in sedimentary rock normally more than 1000 metres below ground. It is extracted using a technique known as hydraulic fracturing or 'fracking'. Is this fossil fuel…?*
> *(a) Boromic gas*
> *(b) Coal*
> *(c) Xenon gas*
> *(d) Shale gas*
> *(e) Tar-sand oil*
> *(f) Don't know*

The first five response options were randomised to prevent response-order bias; participants were requested not to guess if they did not know the answer, but to select 'Don't know'.

The second question asked 'Would you say you are generally in favour or opposed to fracking for shale gas taking place (a) in Britain; (b) within 10 miles of your home?' with a five point response scale from 'Strongly in favour' to 'Strongly opposed' and an additional 'Don't know/Not sure' option.

The next two questions presented respondents with nine positive and nine negative statements about fracking for shale gas, asking them to 'indicate the extent to which you agree or disagree with each one of them'. The order of statements within each question, and the order of question blocks (positive/negative statements grouped together) was randomised to prevent response-order bias. The majority of the statements were taken from an Opinium poll from May 2014 and for purposes of comparison the same responses were used: a five point scale from 'Strongly agree' to 'Strongly disagree' with 'Don't know/not sure' as an additional option. Some extra statements were included relating to other issues raised in debates about fracking that were not incorporated in the original Opinium poll.

Finally, respondents were asked to state from which sources, if any, they had heard or read about fracking for shale gas.

After the first question, which clarified that 'fracking' is an alternative name for the process of hydraulic fracturing, the phrase 'fracking for shale gas' was used throughout the survey. The term 'fracking' is much more frequently employed than 'hydraulic fracturing' (Evensen et al., 2014); its use is widespread in news reports and articles, and I therefore expected it to be the most suitable expression to test because it would be both the most widely recognised and the one which is most commonly applied in debates, shaping opinions. Although Evensen (2016) argues that 'fracking' has negative connotations and should be avoided, Stoutenborough et al. (2016a) found that in the USA, there were no significant differences between attitudes when survey respondents were asked about 'fracking' compared to 'hydraulic fracturing', and they suggest that priming effects may have affected the studies that Evensen discusses (Stoutenborough et al., 2016b). I used the phrase 'fracking for shale gas' rather than simply 'fracking' so as to remind respondents of the purpose of fracking and thus hopefully minimise any biased or vaguely obscene connotations. It is possible that the results that follow are more negative towards fracking than if a different term had been used, but I wanted to examine attitudes in the context of how the debates about hydraulic fracturing are currently framed.

3.3. Data analysis

Responses to question 1 were recoded into a dichotomous variable representing those who answered correctly and those who did not. To facilitate multivariate analyses, responses to questions 2 to 4 were recoded so that 'Don't know/not sure' was combined with the neutral category of the response scales (Neither in favour nor opposed/Neither agree nor disagree). Although conceptually there may be some difference between these amalgamated responses, this recoding is justified because if a 'don't know' option had not been offered it would have been natural for respondents to choose the neutral point of the scale, expressing no decided opinion; further, an uncertain response is clearly between a positive and a negative response when considering the ordering of responses for non-parametric statistical tests (cf. also Andersson-Hudson et al., 2016). Differences in opinions between those who answered question 1 correctly (i.e. who demonstrated a basic level of knowledge about hydraulic fracturing) and those who did not were tested for statistical significance using the Mann-Whitney U test, a non-parametric alternative to the independent samples *t*-test.

4. Results and discussion

4.1. Knowledge about hydraulic fracturing and sources of information

Table 2 shows the results of question 1, testing basic knowledge of hydraulic fracturing. A substantial majority (70.6%) of respondents gave the correct answer. Just over one-fifth of the sample stated 'Don't know', and 7.6% gave an incorrect answer. When this question was first fielded in March 2012 by the Nottingham tracker survey, only 37.6% of participants responded correctly, but knowledge of fracking has increased significantly and these findings are broadly commensurate with Nottingham tracker results from before and after this study, which recorded 72.3% and 74.9% of respondents answering correctly in September 2014 and September 2015 respectively (O'Hara et al., 2015).

This question merely tests rudimentary knowledge that fracking is used to extract shale gas and cannot be regarded as evidence of more detailed understanding. The sources from which respondents had heard about fracking (Table 3) suggest that many may have received only superficial information, primarily from television or radio news, with national British newspapers also important. About 10% of the sample had read books, magazine or journal

articles, which might provide more extensive information. A slightly higher proportion of respondents had received information from non-news websites containing information/arguments against fracking, or from environmental or anti-fracking groups, than from non-news websites containing arguments in favour of fracking.

4.3. Support for fracking

Figures 1 and 2 show respondents' attitudes towards fracking in Britain and within 10 miles of home respectively, with responses disaggregated according to whether participants showed evidence of basic knowledge about hydraulic fracturing by answering question 1 correctly. Overall, more respondents supported fracking in Britain (36%) than opposed it (32%), though the differential is not large (+4%). In comparison, the DECC tracker survey conducted in March 2015 found 24% of the sample supported 'extracting shale gas', while 26% were opposed, a differential of −2% (DECC, 2015). YouGov polls for *The Sunday Times* in January and May 2015[2] showed that 35% and 32% respectively thought Britain should 'start extracting shale gas', while 41% and 43% respectively thought it should not (differentials are −6% and −11%). These polls all provide information about fracking that my survey did not, which may influence the results: the DECC tracker survey framed the question positively (see section 2.2) which might explain the lower opposition, though not the lower level of support; *The Sunday Times* polls mentioned arguments for and against fracking, which might affect the views of respondents who were not aware of fracking previously. While both these surveys used the phrase 'hydraulic fracturing, or "fracking"' in the information given, the actual question they asked was about 'extracting shale gas'. It is interesting, therefore, that my results are more favourable, given that I asked about support for 'fracking', which might be expected to produce more negative results (Clarke et al., 2015; Evensen et al., 2014).

Unsurprisingly, respondents who had basic knowledge of fracking were more likely to express an opinion than those who didn't, but it is not necessarily the case that knowledge increases support: more knowledgeable participants held more polarised views, with a higher proportion both in favour of and opposed to fracking in Britain generally and in their local area. While the differential between the proportion in favour and opposed to fracking in Britain was positive (+6.5%) in the more knowledgeable group compared with a small negative differential (−2.3%) in the other group, a Mann-Whitney U test showed no significant difference in the overall level of support for fracking in Britain between those who evidenced knowledge and those who did not. This appears to be due to the fact that the polarised views cancel out, resulting in a median value the same for the knowledgeable group as for the other group, in which a much higher proportion were neither in favour nor opposed.

These results differ from the findings of the September 2014 Nottingham tracker survey, which showed that respondents who answered the knowledge question correctly were more likely to support fracking than others (Andersson-Hudson et al., 2016). However, that survey design was significantly different: the question about support was asked after several questions about impacts associated with fracking, more of which were positive than negative. This may have influenced the results (which also indicated overall higher support and lower opposition to fracking than the present survey). The DECC tracker survey of March 2015 showed more opposition than support for fracking among respondents who claimed to know 'a lot' and 'a little' about fracking but slightly more support than opposition among those who didn't know about it.

[2] Polls by YouGov for *The Sunday Times,* 29-30 January 2015 and 14-15 May 2015, sample size 1550 and 1567 British adults respectively.

There was notably less support and more opposition towards fracking within 10 miles of home compared to 'in Britain' generally, both among those who evidenced knowledge of fracking and those who didn't. Among the more knowledgeable group, support drops by 15.9 percentage points and opposition rises by 13.1 percentage points, leading to a differential of −22.5%. The differential between support and opposition was −18.6% among the less knowledgeable group. A Mann-Whitney U test indicated a significantly higher level of opposition to fracking in their local area among those who answered the knowledge question correctly than those who didn't (p = .026).

In the sample overall, 22% supported fracking locally, while 45% were opposed. This is similar to results of the YouGov polls for *The Sunday Times* in January and May 2015. The former asked 'Would you support or oppose fracking in your local area if it was within a mile or two of your home?'; 20% of respondents expressed support and 58% opposition. The later poll examined support for fracking 'if it went ahead in a town or village near to you' and found 27% of respondents supportive and 49% opposed. Lower levels of support for energy developments locally compared to 'in Britain' might be regarded as an example of 'NIMBYism' (Not In My Backyard), but some researchers suggest this is an over-simplification that should be avoided or used cautiously (e.g. Burningham, 2000; Devine-Wright, 2005, 2009).

One interesting result is that while support for fracking in their local area was 7% lower among women compared to support for fracking in Britain, the drop in support was much steeper for men, at 17%. Overall, more men were in favour of fracking in Britain than opposed (differential +22%) while for women the differential was −13%. This is similar to other research findings that women tend to express more concern about, and less support for, technologies that are perceived to pose environmental risks (Davidson and Freudenberg, 1996; Siegrist, 2000; Slovic, 1999). But both women and men were more opposed than supportive of fracking 'within 10 miles of your home' (differential −34% and −7% respectively). This suggests either that men are more prone to 'NIMBYism' than women, or that they think differently about a general scenario, with women perhaps more likely to relate the general case to themselves and men more likely to think in the abstract rather than how they would feel if fracking 'in Britain' actually meant 'close to home'. Hypotheses to account for the gender differences that are often found in environmental risk perceptions include biological and social explanations (women are more vulnerable and are nurturers by nature or socialization); information-deficit models (women are more lacking in knowledge than men); and explanations based on gendered differences in power, levels of trust in institutions, and the salience of economic, safety, and parental concerns (Davidson and Freudenburg, 1996; Slovic, 1999). However, these hypotheses do not explain why men might change their views more negatively than women when considering fracking close to home compared to 'in Britain' generally. There needs to be more research on this question.

4.4. Beliefs about fracking

Table 4 shows respondents' beliefs about fracking, compared with results from an Opinium poll fielded in May 2014[3]. Focussing first on results from the present study, it can be seen that while more respondents agreed than disagreed with all the negative statements about fracking, there were three positive statements which garnered more disagreement than agreement: 'Fracking will reduce the UK's carbon footprint' (differential between proportion of the sample who agreed and disagreed: −9%); 'Fracking will reduce my energy bills' (−7%); and 'It's possible to compensate for the risks of fracking by payments to local

[3] Poll by Opinium for GovToday, 9-12 May 2014, sample size 2002 UK adults.

communities' (−7%). Opinion was least divided on the statements 'Fracking will create new jobs' (differential between proportion of the sample who agreed and disagreed: +49%); 'We should invest in renewable energy instead' (+45%); 'Fracking will cause noise and disruption to local residents' (+44%); 'Fracking will reduce the UK's dependency on foreign sources of energy' (+40%); and 'Fracking will damage the local environment' (+36%). There was a positive differential of over 20% between the proportion of respondents who agreed and disagreed with six of the nine negative statements, but this was true of only two of the nine positive statements, indicating that respondents were more united in negative beliefs than positive beliefs about fracking.

The most notable differences between these results and those of the Opinium poll conducted 10 months earlier are the downturn in agreement with three positive statements: 'Fracking will reduce the UK's carbon footprint' (change in the differential between proportion of respondents who agreed and disagreed: −19%); 'Fracking will provide the UK with a secure energy source for decades' (−10%); 'Fracking will reduce my energy bills' (−7%); and one negative statement: 'There is no effective way to regulate fracking to make it safe in the UK' (−9%).

Table 5 details responses about beliefs disaggregated according to whether participants showed evidence of basic knowledge about hydraulic fracturing by answering question 1 correctly. As with the previous questions about support for fracking, respondents who evidenced knowledge held more polarised views than those who didn't, with a higher proportion both agreeing and disagreeing with each statement. Less knowledgeable participants were more likely to agree with the negative statements than the positive ones, suggesting that fracking is approached from an initial position of scepticism.

These results accord with other, deliberative, research which revealed the dominance of risk perceptions in discussions, and scepticism towards benefit-centric government and industry discourses, including doubts about benefits even among respondents initially positive towards fracking (Partridge et al., 2017; Thomas et al., 2017; Williams et al., 2017).

The positive statements were combined into a single scale measuring positive beliefs about fracking (Cronbach's $\alpha = .941$, indicating excellent internal consistency); negative statements were combined into a scale measuring negative beliefs about fracking ($\alpha = .934$). A *t*-test revealed no significant difference between means for the positive beliefs scale between those who answered the knowledge question correctly and those who didn't. In other words, more knowledgeable respondents were not more likely to accept positive arguments about fracking than others overall. However, a *t*-test showed there was a significant difference ($p = .003$) for the negative beliefs scale between the mean for those who answered correctly (2.55) and the mean for those who didn't (2.67); somewhat counterintuitively a lower mean indicates more agreement so more knowledgeable respondents were more likely to agree with the negative statements than less knowledgeable respondents. This echoes Evensen (2017) whose students expressed more negative beliefs about fracking after learning significantly more about it from a range of perspectives.

Mann-Whitney U tests comparing responses to each statement between those who evidenced knowledge of hydraulic fracturing and those who didn't show that more knowledgeable respondents stated significantly higher levels of agreement with three positive statements and six negative statements than less knowledgeable respondents, and lower levels of agreement with three positive statements (see Table 6). All tests are significant at $p < .01$, with a Holm-Bonferroni correction for multiple testing applied.

An interesting result is that more respondents disagreed than agreed that it is possible to compensate for the risks of fracking by payments to local communities. Thomas et al. (2017) found that economic incentive packages were interpreted as bribes; the YouGov poll for *The Sunday Times* in January 2015 revealed that 'substantial' payments to the local council only

increased support and reduced opposition by around 6 percentage points, leaving twice as many people still opposed compared to supportive of fracking in their local area. DECC tracker surveys from Sept 2016 onwards which have asked about this have found only a maximum of 6% of participants supportive of fracking because of the promise of community benefits.

It is notable that respondents were much more in favour of investing in renewables than fracking. This is a common finding: the DECC tracker survey in March 2015 found that 78% of respondents supported use of renewable energy, compared to 24% supportive of shale gas extraction; the Opinium poll of May 2014 found 65% supported wind power compared to 25% supportive of 'fracking/shale gas drilling'.

4.5. Correlations between beliefs and support

Unsurprisingly, there were strong positive correlations between mean scores for the positive beliefs scale and support for fracking in Britain (Spearman's $\rho = .792$) and within 10 miles of home (Spearman's $\rho = .685$). Strong negative correlations exist between mean scores for the negative beliefs scale and support for fracking in Britain (Spearman's $\rho = .756$) and within 10 miles of home (Spearman's $\rho = .746$). There was also a very strong positive correlation between support for fracking in Britain and within 10 miles of home (Spearman's $\rho = .840$). These tests are all significant at $p < .0005$.

In other words, agreement with positive statements is associated with more support and agreement with negative statements with less support for fracking. However, these results are correlational, not necessarily causal; it cannot be assumed that support or opposition is the outcome of beliefs. Research by Evensen and Stedman (2017) suggests that the opposite is true and that attitudes towards fracking shape beliefs about it. This could be due to cultural cognition, whereby individuals' attitudes towards risk, and associated beliefs, are influenced by their values, leading to biased assimilation of information (a tendency to accept information confirming one's views at face value while rejecting disconfirming information as unconvincing) (Kahan, 2010; Kahan et al., 2011; Lord et al., 1979).

5. Conclusions and policy implications

These findings suggest several conclusions of interest to policymakers. First, results of polls which ask about support for fracking/hydraulic fracturing or shale gas extraction *in Britain* (or the UK), including the DECC tracker survey, are not likely to be a good guide to local attitudes towards proposals for specific shale gas wells. This study confirms previous polls (by YouGov for *The Sunday Times* in January and May 2015) which have found significantly less support and more opposition expressed when people are asked about hypothetical developments within their local area rather than more generally. This was especially so of men in this study, so the assertion by Averil Macdonald, the chair of UK Onshore Oil and Gas, that men understand 'the facts' and are therefore persuaded of the benefits of fracking, unlike women (Turner, 2015), is brought into question.

Nor should it be assumed that more knowledge about fracking will necessarily lead to more positive beliefs about it, or more support for shale gas developments. More knowledgeable respondents in this study held more polarised views, with a higher proportion both in favour of and opposed to fracking in Britain generally and in their local area. Statistical tests showed no significant difference in the overall level of support for fracking in Britain, and significantly less support for fracking in their local area, among those who evidenced knowledge compared to those who did not. More knowledgeable respondents were

no more likely to accept positive arguments about fracking than others overall, but *were* more likely to agree with the negative statements than less knowledgeable respondents.

A necessary caveat is that this study only tested for very basic knowledge of fracking and it may be that it is possible to educate the general public (or at least residents in areas where shale gas extraction is proposed), to be more knowledgeable than respondents in this study, or to consider different information to that which they are currently aware of, and that this would make a difference to beliefs and attitudes (see e.g. Whitmarsh et al., 2015). However, Thomas et al. (2017) found that after day-long deliberative workshops at which participants engaged in full consideration of detailed, balanced information about shale gas and oil extraction by hydraulic fracturing, more participants felt the risks outweighed the benefits than vice versa, although most had initially felt neutral or undecided. Thus, honest presentation of unbiased information may not have the effect on beliefs and support that policymakers desire.

A third point is that acceptance of economic arguments about the benefits of fracking/shale gas extraction is not enough to ensure support. The proportion of respondents who agreed with the statements 'Fracking will provide the UK with a secure energy source for decades' 'Fracking will reduce the UK's dependency on foreign sources of energy', 'Fracking will create new jobs' and 'Fracking will boost economic growth' was higher (often considerably so) than the proportion who stated that they support fracking in Britain and locally. Indeed, among the sample as a whole, as well as the more knowledgeable respondents, a majority agreed with the arguments about jobs and dependency on foreign sources of energy, though less than half support fracking. Rejection of fracking is apparently not due simply to lack of acceptance that there will be such benefits, although other research shows that the public are suspicious of the UK Government's claims about the benefits of fracking (Partridge et al., 2017). Policymakers and industry actors should not expect to win support for fracking from the British public by over-reliance on claims about the alleged economic advantages of shale gas extraction.

Similarly, arguments about the negative impacts of fracking do not necessarily sway everyone who agrees with them, although they seem to have more effect when people consider fracking potentially happening near where they live. A higher proportion of respondents agreed with all the negative statements in this survey than expressed opposition to fracking in Britain, but in the case of fracking near home, only the statements 'Fracking will cause noise and disruption to local residents', 'Fracking will damage the local environment', and 'We should invest in renewable energy instead' garnered a higher percentage of respondents agreeing than the percentage expressing opposition to fracking. It may be that these concerns carry less weight with some people than benefits or other negative impacts.

The high level of agreement with the negative statements suggest that it is these beliefs, more than lack of agreement about economic benefits, that are driving opposition to fracking. Respondents are also more inclined to disagree than agree that fracking for shale gas will reduce the UK's carbon footprint and individuals' energy bills. It is important that policymakers engage with these concerns, rather than dismissing them; it is simply not the case that 'on one side there are scientific facts […] on the other emotional fears' (Macdonald, 2015). The risks and benefits of fracking are contested; the more knowledgeable respondents' polarised views reflect scientific literature rather than opposing it (cf. Engelder, 2011; Howarth and Ingraffea, 2011; Sovacool, 2014).

A final policy implication is that payments to local communities may not be the (best) way to win their support for fracking in their area, since these promised financial benefits are not seen as adequately offsetting risks. As discussed in section 4.4, other research suggests that community payments are viewed with cynicism and will only affect attitudes in a small

proportion of people. Policymakers may be more likely to increase support by seeking to establish trust and engage in genuinely inclusive and participatory decision-making, including extending the debate beyond short-term considerations of economic benefits to include wider concerns about sustainability, climate change, and energy demand which are of concern to the UK public (Demski et al., 2015; Partridge et al., 2017). This is likely to require responsiveness to public concerns, submitting both alleged benefits and risks of fracking to equal levels of scrutiny (Williams et al., 2017). Willingness to reconsider the desire to go 'all out for shale' if the balance of evidence, or new evidence, requires it, while being transparent about the weighing of risks and benefits in any decisions made to allow hydraulic fracturing and shale gas extraction would also be advisable. It may be that if the public believes that the Government and industry actors are being entirely open with information about fracking, and feels properly involved in developing the rationale for decisions, that the 'bad governance' discourse which is a powerful negative frame in UK fracking debates (Bomberg, 2017) can be overturned and (some) shale gas extraction might be supported. On the other hand, if policymakers wish to adopt a policy that will require little work to win significant approval, they might be better considering going 'all out for renewables' instead.

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Table 1
Sample characteristics

Characteristic	Categories	% of sample
Age	18–24	11.9
	25–39	25.3
	40–59	34.2
	60+ (max 87)	28.6
Gender	Male	48.5
	Female	51.5
Highest qualification	No formal qualifications	6.4
	Secondary school qualifications	33.7
	Vocational qualifications	10.2
	Some HE/other technical or professional qualifications	19.9
	University degree	20.3
	Postgraduate degree	6.8
	Don't know/prefer not to say	2.8
Household income	< £25,000	29.8
	£25,000 – £49,999	30.7
	£50,000 – £69,999	8.9
	£70,000 – £99,999	4.3
	£100,000 – £149,999	1.8
	£150,000 +	0.7
	Don't know/prefer not to say	23.7
Social class	AB	28.0
	C1	29.0
	C2	21.0
	DE	22.0
Vote 2010	Conservative	29.6
	Labour	25.4
	Liberal Democrat	20.3
	Scottish National Party	1.6
	Plaid Cymru	0.2
	Green	1.1
	UK Independence Party	1.9
	British National Party	0.9
	Other party	0.3
	Don't know/did not vote	18.6
Newspaper readership	Broadsheet right leaning	7.6
	Broadsheet left leaning	5.2
	Tabloid right leaning	32.7
	Tabloid left leaning	8.3
	Regional/local daily paper	4.5
	Other newspaper	6.9
	No newspaper	34.6

Table 2
Knowledge: Responses to Question 1

Response	N	%
Shale gas (correct)	1231	70.6
Coal	80	4.6
Tar-sand oil	28	1.6
Boromic gas	16	0.9
Xenon gas	9	0.5
Don't know	381	21.8

Table 3
Sources of information about fracking

Source	%[a]
Television or radio news	71.0
National British newspaper(s) (print or online editions)	44.0
Local newspaper(s)	15.0
Social media (e.g. Twitter, Facebook)	14.7
People I know personally (e.g. friends, family, colleagues)	14.1
Non-news websites containing information/arguments against fracking	11.5
Environmental/anti-fracking groups via leaflets, newsletters, films or events	11.3
Books, magazines or scientific journals	9.8
Non-news websites containing information/arguments in favour of fracking	9.0
Unsure/none of these	16.1

[a] Figures sum to more than 100% as respondents could choose as many sources as relevant

Table 4
Beliefs about fracking (all figures are percentages)

	This survey, March 2015			Opinium poll, May 2014		
	Agree	**Disagree**	**Diff.[a]**	**Agree**	**Disagree**	**Diff.[a]**
Positive statements						
Fracking will provide the UK with a secure energy source for decades	37	21	+16	41	15	+26
Fracking will reduce the UK's dependency on foreign sources of energy	52	12	+40	52	11	+41
Fracking will reduce the UK's carbon footprint	21	31	−9	30	20	+10
Fracking will reduce gas prices for energy companies	34	24	+10	33	20	+13
Fracking will reduce my energy bills	23	30	−7	26	26	0
Fracking will be safe if it is regulated and monitored properly	36	26	+10	33	25	+8
Fracking will create new jobs[b]	58	9	+49	48	11	+37
Fracking will boost economic growth[b]	36	18	+18			
It's possible to compensate for the risks of fracking by payments to local communities	25	32	−7	N/A	N/A	N/A
Negative statements						
Fracking will have no effect on reducing energy bills	36	22	+14	34	18	+16
Fracking will cause noise and disruption to local residents	53	9	+44	50	10	+40
Fracking will damage the local environment	49	13	+36	46	13	+33
Fracking could cause earthquakes and tremors	38	15	+23	37	16	+21
Fracking could contaminate local water sources	42	13	+29	39	13	+26
There is no effective way to regulate fracking to make it safe in the UK	32	25	+7	34	18	+16
Fracking will keep the UK tied to using fossil fuels, which contribute to climate change	42	13	+29	N/A	N/A	N/A
Fracking will create health risks	31	19	+12	N/A	N/A	N/A
We should invest in renewable energy instead	56	11	+45	N/A	N/A	N/A

a. Diff. = differential between percentage who agree and disagree
b. In the Opinium poll, these two statements were combined as one: Fracking will create new jobs and boost economic growth

Table 5
Beliefs about fracking disaggregated by knowledge (all figures are percentages)

	Response to knowledge question					
	Correct			Not correct		
	Agree	**Disagree**	**Diff.[a]**	**Agree**	**Disagree**	**Diff.[a]**
Positive statements						
Fracking will provide the UK with a secure energy source for decades	43.5	25.1	+18.4	21.4	10.8	+10.6
Fracking will reduce the UK's dependency on foreign sources of energy	61.0	14.8	+46.2	29.2	6.5	+22.7
Fracking will reduce the UK's carbon footprint	22.5	35.7	−13.2	17.0	13.9	+3.1
Fracking will reduce gas prices for energy companies	39.9	27.1	+12.8	20.7	15.2	+5.5
Fracking will reduce my energy bills	26.5	34.9	−8.4	16.2	16.7	−0.5
Fracking will be safe if it is regulated and monitored properly	42.9	29.7	+13.2	20.1	15.9	+4.2
Fracking will create new jobs	67.5	10.5	+57.5	36.9	6.8	+30.1
Fracking will boost economic growth	42.5	20.6	+21.9	21.6	10.8	+10.8
It's possible to compensate for the risks of fracking by payments to local communities	27.8	38.8	−11.0	15.9	17.7	−1.8
Negative statements						
Fracking will have no effect on reducing energy bills	39.1	27.7	+11.4	26.2	8.9	+17.3
Fracking will cause noise and disruption to local residents	59.7	11.8	+47.9	38.8	5.5	+33.3
Fracking will damage the local environment	54.5	16.6	+37.9	35.0	5.5	+29.5
Fracking could cause earthquakes and tremors	43.2	18.8	+24.4	23.9	7.7	+16.2
Fracking could contaminate local water sources	46.2	14.9	+31.3	31.9	5.9	+26.0
There is no effective way to regulate fracking to make it safe in the UK	34.7	31.3	+3.4	25.2	8.2	+17.0
Fracking will keep the UK tied to using fossil fuels, which contribute to climate change	48.6	16.9	+31.7	27.1	6.7	+20.4
Fracking will create health risks	33.1	23.0	+10.1	26.5	9.4	+17.1
We should invest in renewable energy instead	61.5	13.4	+48.1	42.1	5.4	+36.7

a. Diff. = differential between percentage who agree and disagree

Table 6
Beliefs about fracking comparing more knowledgeable respondents to others

	More knowledgeable respondents vs. others
Positive statements	
Fracking will provide the UK with a secure energy source for decades	Not significant
Fracking will reduce the UK's dependency on foreign sources of energy	Higher agreement
Fracking will reduce the UK's carbon footprint	Lower agreement
Fracking will reduce gas prices for energy companies	Not significant
Fracking will reduce my energy bills	Lower agreement
Fracking will be safe if it is regulated and monitored properly	Not significant
Fracking will create new jobs	Higher agreement
Fracking will boost economic growth	Higher agreement
It's possible to compensate for the risks of fracking by payments to local communities	Lower agreement
Negative statements	
Fracking will have no effect on reducing energy bills	Not significant
Fracking will cause noise and disruption to local residents	Higher agreement
Fracking will damage the local environment	Higher agreement
Fracking could cause earthquakes and tremors	Higher agreement
Fracking could contaminate local water sources	Higher agreement
There is no effective way to regulate fracking to make it safe in the UK	Not significant
Fracking will keep the UK tied to using fossil fuels, which contribute to climate change	Higher agreement
Fracking will create health risks	Not significant
We should invest in renewable energy instead	Higher agreement

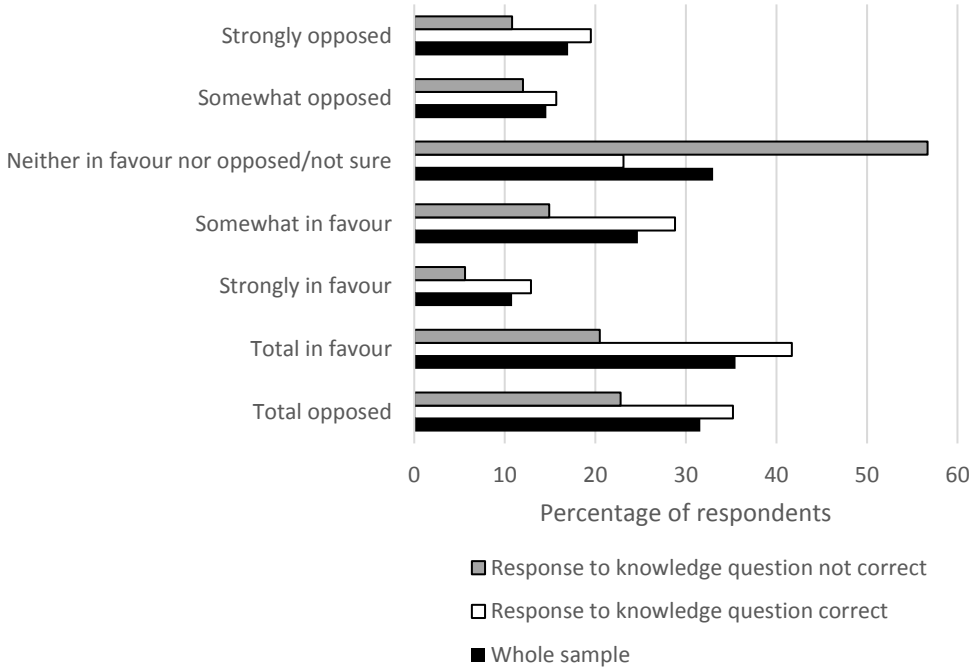

Figure 1: Attitudes towards fracking in Britain

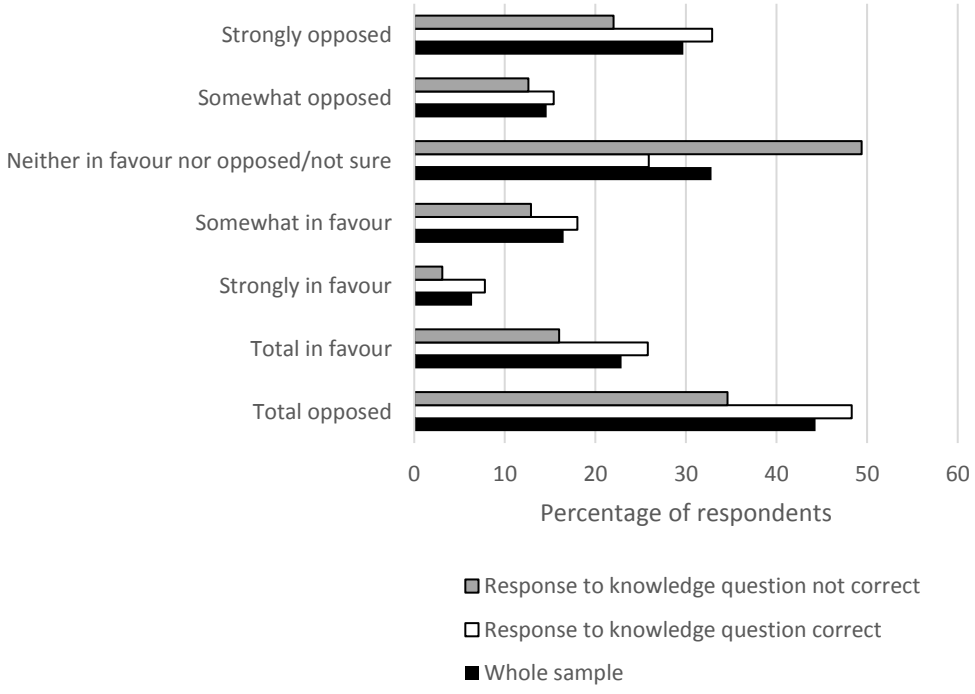

Figure 2: Attitudes towards fracking ‘within 10 miles of your home’